Liquefied Natural Gas and Floating LNG
A technology review

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Construction Costs

Range of liquefaction project costs: $200 - $2,000+ per ton
1 Bcf/d of capacity = $1.5B to $15.0B+
Corpus Christi liquefaction project estimated costs are ~$800/ton
Sabine Pass Trains 5 & 6 estimated costs are ~$550/ton

Gorgon $52 Billion dollars

King & Spalding 2014
<table>
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<th>TABLE OF CONTENTS</th>
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<td>• FLNG Projects in the pipeline, <em>or in the boat?</em></td>
</tr>
</tbody>
</table>
Approved LNG Plants

Import Terminal

APPROVED - NOT UNDER CONSTRUCTION
U.S. - MARAD/Coast Guard
1. Gulf of Mexico: 1.0 Bcf/d (Main Pass McMoRan Exp.)
2. Offshore Florida: 1.2 Bcf/d (Hoëgh LNG - Port Dolphin Energy)
3. Gulf of Mexico: 1.4 Bcf/d (TORP Technology-Bienville LNG)
4. Corpus Christi, TX: 0.4 Bcf/d (Cheniere - Corpus Christi LNG) (CP12-507)

Export Terminal

APPROVED - UNDER CONSTRUCTION
U.S. - FERC
5. Sabine, LA: 2.76 Bcf/d (Cheniere/Sabine Pass LNG) (CP11-72 & CP14-12)
6. Hackberry, LA: 1.7 Bcf/d (Sempra - Cameron LNG) (CP13-25)
7. Freeport, TX: 1.8 Bcf/d (Freeport LNG Dev/Freeport LNG Expansion/FLNG Liquefaction) (CP12-509)
8. Cove Point, MD: 0.82 Bcf/d (Dominion - Cove Point LNG) (CP13-113)
9. Corpus Christi, TX: 2.14 Bcf/d (Cheniere - Corpus Christi LNG) (CP12-507)

As of February 5, 2015

FERC
Proposed LNG Plants in North America

Export Terminal

1. Coos Bay, OR: 0.9 Bcf/d (Jordan Cove Energy Project) (CP13-483)
2. Lake Charles, LA: 2.2 Bcf/d (Southern Union - Trunkline LNG) (CP14-120)
3. Astoria, OR: 1.25 Bcf/d (Oregon LNG) (CP09-6)
4. Lavaca Bay, TX: 1.38 Bcf/d (Excellerate Liquefaction) (CP14-71 & 72)
5. Elba Island, GA: 0.35 Bcf/d (Southern LNG Company) (CP14-103)
7. Lake Charles, LA: 1.07 Bcf/d (Magnolia LNG) (CP14-347)
9. Sabine Pass, TX: 2.1 Bcf/d (ExxonMobil – Golden Pass) (CP14-517)
10. Pascagoula, MS: 1.5 Bcf/d (Gulf LNG Liquefaction) (PF13-4)
11. Plaquemines Parish, LA: 0.30 Bcf/d (Louisiana LNG) (PF14-17)
12. Robbinston, ME: 0.45 Bcf/d (Kestrel Energy - Downeast LNG) (PF14-19)
13. Cameron Parish, LA: 1.34 Bcf/d (Venture Global) (PF15-2)
14. Jacksonville, FL: 0.075 Bcf/d (Eagle LNG Partners) (PF15-7)

PROPOSED CANADIAN SITES IDENTIFIED BY PROJECT SPONSORS

15. Kitimat, BC: 1.28 Bcf/d (Apache Canada Ltd.)
16. Douglas Island, BC: 0.23 Bcf/d (BC LNG Export Cooperative)
17. Kitimat, BC: 3.23 Bcf/d ( LNG Canada)

FERC, Feb 5 2015

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## LNG Specifications

<table>
<thead>
<tr>
<th>component</th>
<th>limit</th>
<th>comments</th>
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<tbody>
<tr>
<td>CO₂</td>
<td>50 ppm</td>
<td>freezing</td>
</tr>
<tr>
<td>H₂S</td>
<td>3.5 ppm</td>
<td>LNG Spec</td>
</tr>
<tr>
<td>total sulfur</td>
<td>20-25 mg/m³</td>
<td>LNG Spec</td>
</tr>
<tr>
<td>mercury</td>
<td>.01 µg/Nm³</td>
<td>aluminum exchangers</td>
</tr>
<tr>
<td>C₅⁺</td>
<td>&lt;0.1% mol</td>
<td>issues in liquefaction section</td>
</tr>
<tr>
<td>benzene</td>
<td>&lt;1 ppm (mole)</td>
<td></td>
</tr>
<tr>
<td>water</td>
<td>1 ppmv</td>
<td>freezing in liquefaction section</td>
</tr>
<tr>
<td>nitrogen</td>
<td>1% mol</td>
<td></td>
</tr>
<tr>
<td>ethane</td>
<td>&lt;6-8% mol</td>
<td>Ethylene</td>
</tr>
<tr>
<td>propane</td>
<td>&lt;3% mol</td>
<td></td>
</tr>
<tr>
<td>butane</td>
<td>&lt;2% mol</td>
<td></td>
</tr>
<tr>
<td>heating value</td>
<td>1050 BTU/SCF</td>
<td>Europe and USA</td>
</tr>
<tr>
<td></td>
<td>1140 BTU/SCF</td>
<td>East Asia</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>melting point</th>
<th>°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>pentane</td>
<td>-202</td>
</tr>
<tr>
<td>hexane</td>
<td>-139</td>
</tr>
<tr>
<td>heptane</td>
<td>-131</td>
</tr>
</tbody>
</table>

LNG temp
-161°C
-258°F
• Trends in LNG Train Size, MTPY
• LNG Refrigerant Compressor Drives
• Gas Turbines Driver Benefits
• Aeroderivative vs Industrial Turbines
• Inlet Turbine Cooling
Trends in LNG Train Size, MTPY

5 MTPY, 86MW turbine, GE Frame 7EA
8 MTPY, 123 MW turbine, GE Frame 9E

Buonocristiano et al, GE

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Gas Turbines Driver Benefits

- Smaller plot space
- Shorter delivery time
- Lower transportation costs
- Lower installation costs
- Lower foundation costs
- No need for boiler feed water treatment
- No need for cooling water

Cyrus Meher et al, Bechtel
Aeroderivative vs Industrial Turbine

Industrial Frame 9E, 123 MW

Aeroderivative LMS 100, 100 MW

General Electric

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## Aeroderivative vs Old Industrial Turbines

<table>
<thead>
<tr>
<th></th>
<th>Old Heavy Industrial</th>
<th>Aeroderivative</th>
</tr>
</thead>
<tbody>
<tr>
<td>speed</td>
<td>slower</td>
<td>faster</td>
</tr>
<tr>
<td>starting time</td>
<td>10-15min</td>
<td>5 min</td>
</tr>
<tr>
<td>loading time</td>
<td>6-10% per minute, some in 13 min</td>
<td>10 min</td>
</tr>
<tr>
<td>maintenance time</td>
<td>more</td>
<td>less</td>
</tr>
<tr>
<td>bearings</td>
<td>hydrodynamic</td>
<td>antifriction</td>
</tr>
<tr>
<td>technology</td>
<td>conventional</td>
<td>aerospace</td>
</tr>
<tr>
<td>modularity</td>
<td>none</td>
<td>highly modular</td>
</tr>
<tr>
<td>efficiency</td>
<td>less</td>
<td>10-15% more</td>
</tr>
<tr>
<td>temperature</td>
<td>lower</td>
<td>higher</td>
</tr>
<tr>
<td>emissions</td>
<td>higher</td>
<td>lower</td>
</tr>
<tr>
<td>compression ratio</td>
<td>lower, 10</td>
<td>higher, 18</td>
</tr>
<tr>
<td>reliability</td>
<td>lower</td>
<td>higher</td>
</tr>
<tr>
<td>load range</td>
<td>narrow</td>
<td>wider</td>
</tr>
<tr>
<td>operational expenses</td>
<td>higher</td>
<td>lower</td>
</tr>
<tr>
<td>price</td>
<td>20-30% lower</td>
<td>higher</td>
</tr>
<tr>
<td>air inlet system requirements</td>
<td>low inlet Mach number</td>
<td>high inlet Mach number</td>
</tr>
<tr>
<td>fuel requirements</td>
<td>wider range of fuels</td>
<td>narrower range of fuels</td>
</tr>
<tr>
<td>footprint</td>
<td>bigger</td>
<td>less than 50%</td>
</tr>
<tr>
<td>weight</td>
<td>more</td>
<td>less than 40%</td>
</tr>
</tbody>
</table>

\[ n_B = 1 - \frac{T_{\text{atmospheric}}}{T_{\text{compressor exit}}} \]

Firing temperature from 1149°C to 1400°C
Efficiencies from 30/50% to 40/60%

New turbines have integrated a lot of the aeroderivative benefits but they need to be requested.

Lawrence Kaempfper, P.Eng.
Amin Almasi

Gabriel Castaneda, P.E.
• Increased LNG production

Assuming that the plant is designed such that the gas turbine driver becomes a production bottleneck during hot weather.

• More stable liquefaction process, minimizes production swings

• Possible optimization of compressor selections for the liquefaction process.

• Chilled water-glycol loop

0.7%/°C heavy duty, 1%/°C for aeroderivative

Technology is commonly used in Power Plants

11 LNG COP Optimized Cascade Process plants

John Forsyth, P.Eng.
Mehaboob Basha et al
Cyrus Meher- Homji
Shell, GE

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Emissions in LNG – Table of Contents

- Causes and mitigation measures
- Relative CO$_2$ emissions of gas turbines
- NO$_X$ emissions
- BOG compressors
# CO₂ Emission Causes – Mitigation Measures

<table>
<thead>
<tr>
<th>Causes</th>
<th>Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of turbines to power up plant</td>
<td>• Use aeroderivative/ new efficient turbines</td>
</tr>
<tr>
<td></td>
<td>• Install waste heat recovery units, 9% reduction</td>
</tr>
<tr>
<td></td>
<td>• Use a more efficient liquefaction technology</td>
</tr>
<tr>
<td>Flaring and venting</td>
<td>• Use of boil-off gas compressors during ship loading operations</td>
</tr>
<tr>
<td></td>
<td>• Use a compressor to capture gas to be flared and route it to be used as fuel gas</td>
</tr>
<tr>
<td>Furnaces</td>
<td>• Install high efficiency burners in furnaces</td>
</tr>
</tbody>
</table>

Gas to be flared comes from fired heaters, incinerators, venting, startup and shutdown conditions, depressurization of plant

Australia Pacific LNG Project

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Relative CO$_2$ Emissions From Different Gas Turbines

Cyrus Meher- Omji et al
Bechtel

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Equivalence Ratio = \frac{(\text{fuel/oxidant})_{\text{actual}}}{(\text{fuel/oxidant})_{\text{stoichiometric}}}

Cyrus Meher-Homji et al
Bechtel

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LNG Process Safety – Table of Contents

• 49 CFR-193, 33 CFR 127 and NFPA 59A standards
• LNG vapor characteristics
• Liquid Spill Hazard
• Thermal Radiation Hazard
• Overpressure Hazard
• Overpressure vs. Gas Type
LNG Process Safety

- 33 CFR 127 Waterfront Facilities Handling Liquefied Natural Gas and Liquefied Hazardous Gas

49-CFR-193 is based on NFPA 59A, 2001
• Protection of persons and property near an LNG facility from:
  - Thermal radiation
  - Dispersion and delayed ignition
  - Explosions arising from an LNG spill

• Reduction of the potential for a catastrophic spill of LNG
• Sets design spill requirements for each specific major area:
  - LNG storage tanks
  - Vaporization areas
  - Process areas
  - Transfer Areas
Methane is denser than air by a factor of 1.5, propane by about 2, LNG spills will behave as a dense gas.

LNG vapor characteristics

Vapor Fences
Precast lightweight concrete
8-12ft, 20ft high
Yield below 1psig threshold
10 min spill
Flammable vapor dispersion
Vapor cloud at ½ LFL

FLACS – vapor dispersion and deflagration
PHAST – screening calculation on flow rate, rainout and unobstructed vapor dispersion
Pool fires

LNGFIRE3
Predicts thermal radiation from onshore LNG pool fires

49 CFR 193

Jordan Cove Point LNG

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Overpressure Hazard

DOT requirement is 1 psi at facility boundaries

0.5 psi overpressure in FLACS for safety factor

Ignition of vapor clouds in congested areas

<table>
<thead>
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<th>Effect</th>
<th>Overpressure, psi</th>
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<tr>
<td>Eardrum rupture</td>
<td></td>
</tr>
<tr>
<td>Threshold</td>
<td>5</td>
</tr>
<tr>
<td>50% (20 or more years old)</td>
<td>15-20</td>
</tr>
<tr>
<td>Lung Damage</td>
<td></td>
</tr>
<tr>
<td>Threshold</td>
<td>12 (8-15)</td>
</tr>
<tr>
<td>Severe</td>
<td>25 (20-37)</td>
</tr>
<tr>
<td>Lethal</td>
<td></td>
</tr>
<tr>
<td>Threshold</td>
<td>40 (30-50)</td>
</tr>
<tr>
<td>50 percent</td>
<td>62 (50-75)</td>
</tr>
<tr>
<td>100 percent</td>
<td>92 (75-115)</td>
</tr>
</tbody>
</table>

Effects of Nuclear Weapons, Atomic Energy commission, 1977

Gabriel Castaneda, P.E.
Maximum Overpressure vs Gas Type

Flammability limits for the different components are taken into consideration in the simulations.

Structural Response analysis – Abaqus Simulia / USFOS

DNV-RP-C204 Design against accidental loads

Skikda, Algeria, 2004

Kiminori Takahashi et al
JGC Corporation

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**LNG Safety – CFD Explosion Modeling**

**Autoreagas, FLACS, CFX** are standard in Offshore Industry. **TNT** model is an empirical model and is not used in Offshore.

CFD models should require:

- Fuel type (reactivity of fuel)
- Stoichiometry of fuel
- Ignition source type and location
- Confinement and venting (location and size)
- Initial turbulence level in the cloud
- Blockage ratios
- Size, shape and location of obstacles
- Number of obstacles (for a given blockage ratio)
- Cloud size

Explosion effects will depend on maximum pressure, duration of the shock wave and interaction with structures.

Hocquet, Technip

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Explosion Blast Simulators

**CFD**
https://www.youtube.com/watch?v=zjRlKTzS5_c
https://www.youtube.com/watch?v=wWv2MdP-IG0
https://www.youtube.com/watch?v=QxaKxVAR1g0

**FEA**
https://www.youtube.com/watch?v=jESt5lpjhu8
https://www.youtube.com/watch?v=uFSiG7PY23M
https://www.youtube.com/watch?v=T6PyX8rUyL4
https://www.youtube.com/watch?v=WGqC0JPFi_Y

**Other**
https://www.youtube.com/watch?v=fmKKFKfREu8Q

Abaqus Simulia Regas

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• Single Refrigerant
• Mixed Refrigerant
• Refrigerants and Shaftwork
• Selection of Mixed Refrigerant Composition
• Liquefaction Processes
• Natural Gas Cooling Curves
• Liquefaction Technologies – General Comparison
• Liquefaction Technologies – Relative Specific Work
• Liquefaction Technologies - FLNG
• DMR Process - FLNG
Single or Mixed Refrigerant?
Single Refrigerant

Frank Del Nogal
Mixed Refrigerant

Condenser

Evaporator

$T$ (Process)

$H$ (Refrigerant)

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Natural gas MR: 8% N2, 45% C1, 45% C2, 2% C3

Lee
Selection of Mixed Refrigerant Composition

C1 to C3 and Nitrogen

Given \( \{X_i\} \)

Update \( \{X_i\} \)

Generate hot composite curve

Update \( \{X_i\} \)

Produce pseudo-cold composite curve

Is \( |\bar{T} - \hat{T}| \) minimal?

Yes

No

\( X_i : \) composition of component \( i \)

END

Natural gas MR: 8% N2 45% C1, 45% C2, 2% C3

Lee
Natural Gas Cooling Curves

Il Moon et al

LNG

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### Liquefaction Technologies – General Comparison

<table>
<thead>
<tr>
<th>Process</th>
<th>SMR</th>
<th>Cascade</th>
<th>DMR</th>
<th>C3-MR</th>
<th>AP-X</th>
<th>N2 Expansion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Heat Exchanger</td>
<td>PFHE</td>
<td>PFHE</td>
<td>SWHE</td>
<td>SWHE</td>
<td>SWHE</td>
<td>PFHE</td>
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<tr>
<td>Equipment Count</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>H</td>
<td>L</td>
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<tr>
<td>Hydrocarbon Refrigeration Storage</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>H</td>
<td>N/A</td>
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<td>CAPEX</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Capacity, mtpa</td>
<td>2-2.5</td>
<td>4</td>
<td>11</td>
<td>8</td>
<td>11</td>
<td>2</td>
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<tr>
<td>Licensor</td>
<td>BV (Prico), APCI</td>
<td>COP</td>
<td>Shell, APCI</td>
<td>Shell, APCI</td>
<td>APCI</td>
<td>KA, Linde, Costain, etc</td>
</tr>
</tbody>
</table>

**PHFE** – plate fin heat exchanger  
**SWHE** – spiral wound heat exchanger, coil wound heat exchanger

L – Low  
M – Medium  
H – High  
N/A – Not applicable

AP-X used the recently introduced Frame 9 turbine of GE in Qatar  
5 MTPA corresponds to a GE Frame 7
<table>
<thead>
<tr>
<th>PROCESS</th>
<th>Finn et al (relative to Cascade)</th>
<th>Dam et al (relative to MFC)</th>
<th>Foerg (relative to MFC)</th>
<th>Vink et al (relative to C3-MR)</th>
<th>Barclay et al (relative to C3-MR)</th>
<th>Pwaga (relative to DMR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cascade</td>
<td>1.0</td>
<td>1.4</td>
<td>1.2</td>
<td>1.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SMR</td>
<td>1.3</td>
<td>1.1</td>
<td>1.1</td>
<td>1.2</td>
<td></td>
<td>1.1</td>
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<tr>
<td>C3-MR</td>
<td>1.2</td>
<td>1.1</td>
<td>1.0</td>
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<td>1</td>
<td>1</td>
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<tr>
<td>DMR</td>
<td></td>
<td>1</td>
<td>1.0</td>
<td></td>
<td></td>
<td>1</td>
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<tr>
<td>MFC</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>single N2 Expander</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.1</td>
</tr>
<tr>
<td>C3 precooled single N2 expander</td>
<td>1.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.3</td>
</tr>
<tr>
<td>double N2 Expander</td>
<td>1.7</td>
<td></td>
<td></td>
<td></td>
<td>1.4</td>
<td>1.5</td>
</tr>
<tr>
<td>NICHE LNG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Walter Chukwunonso et al

Pwaga
DMR Process

- APCI mentions that it is safer on FLNG applications as it has less propane
- DMR process has less equipment and allows a wider range of operating conditions than C3MR
- DMR process has more exploitable power than C3MR
- DMR has more specific capacity than C3MR process
LNG selection based on capacity

<table>
<thead>
<tr>
<th>Capacity, MTPA</th>
<th>Liquefaction Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.2</td>
<td>Expander processes</td>
</tr>
<tr>
<td></td>
<td>Nitrogen expander</td>
</tr>
<tr>
<td></td>
<td>Feed Gas (Niche Process)</td>
</tr>
<tr>
<td>2 - 3</td>
<td>Single Mixed Refrigerant, PRICO</td>
</tr>
<tr>
<td>&gt; 3</td>
<td>DMR</td>
</tr>
</tbody>
</table>

Based on efficiency, complexity, capital investment, equipment count, safety

MTPA – million tons per year

Gabriel Castaneda, P.E.
• Process Design Considerations
  – Process Flexibility
  – Motion
    - Sloshing
    - Distillation
    - Separators
  – Weight and Space Limits
  – Safety

• Commercial FLNG projects
• Processes need to be flexible as the ship will change location.
• Changes in gas composition affect the entire process:
  – CO$_2$/H$_2$S removal
  – HRU (demethanizer)
  – Compressors
  – Mixed Refrigerant Compositions
Sloshing leads to high impact pressures on thermal insulation, which translates in maintenance downtimes.

Tanks need to withstand sloshing effects, currently GTT has a membrane based design that is favored by the industry because it is efficient and is cost effective.
• Reduction in performance from 10 to 60%
• Random and structured packing are less sensitive to motion than trays.
• Mellapack can be three times less affected by motion than pall rings.
• L/Ds of 2 or less and frequent redistributors. Redistributors may have a higher residence time.
• 50 ppmv CO$_2$ to HRU tower, <0.1% mol C5+ to liquefaction section

Gamma Tomography

Weiss et al, Total, IFP
Tim Cullinane et al, Exxon

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Distillation - Amine System

Solvent Circulation Rate

- Solvent circulation 1 < 2 < 3

Membrane Stage Effect

- Two Stage
- One Stage

Treated Gas to LNG

Feed Gas

Permeate Gas

Acid Gas

CO₂ + H₂S

Water

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FLNG - Separators

Compartmentalizing Baffles (6)

Dampening Baffles (4)

Demister w/ Supports

Inlet

Coalescing Media w/ Support Structure

Gas

Oil

Water

Sloshing in a horizontal drum equipped with baffles

Hamworthy

FMC

Natco

Gabriel Castaneda, P.E.
• Layout, check valves and process control should enforce the flow direction within the process

• Layout of equipment should follow a homogeneous weight distribution to decrease oscillations/improve stability
• Eliminates typical wave inducing fatigue loads
• Minimal hull deflections (sag/hog) simplifying topside design
• Hull does not need to rotate even in harshest environmental conditions
• Eliminates turret and swivel
• Tolerant for weather spreading (waves/wind/current from different directions)
• Mechanical fatigue on distillation columns and cold box
• Load assessments
• Full mechanical /naval considerations
• 10 times more heat transfer surface per unit volume
• Temperature approach of 2°F/1°F (instead of 15°F)
• Lower capital costs
• 75% less weight
• Less plant space, about 50% of size of shell and tube
• Lower compressor power
• No mechanical joints, less prone to leaks
- American Bureau of Shipping (ABS)
- Society of International Gas Tanker and Terminal Operations (SIGTTO)
- Topsides Arrangements
- Main Process Hazards
- Mitigation of Explosion Hazards
- Cryogenic Spills Handling
LNG is stored at -161\(^\circ\)C
Propane at -42\(^\circ\)C
Butane at -12\(^\circ\)C
Leak Hazards
- Asphyxiation Risk
- Explosion Risk
- Cryogenic Spill Risk
  - Embrittlement of steel structures (module structure, hull)

- BLEVE Hazard (C2+ vessels)
- Management of Rapid Phase Transition
  Kevlar
• Promote ventilation
  – Grated vs Plated Process Decks
  – Limitation of module congestion level
  – Optimization of module arrangement and ventilation

• Minimizing LPG inventories

ENI, Gavelli
Effects
Embrittlement of steel structures (module structure, hull)

Solutions
• Minimize leak points (flanges, pumps, valves)
  – HSE hydrocarbon release database (HCRD)
• Collect spill locally
• Direct overboard
• Use polyurethane, wood or concrete insulation to avoid contact with metal structures
• Use insulation and spray guards to protect personnel
• Collect smaller spills locally in drip trays of suitable material (Stainless Steel)
FLNG Projects in the pipeline boat

KPMG, September 2014

Gabriel Castaneda, P.E.
<table>
<thead>
<tr>
<th>Project</th>
<th>Exmar</th>
<th>Exmar 2</th>
<th>PFLNG 1</th>
<th>PFLNG 2</th>
<th>Prelude</th>
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Japan imported 37% of global LNG in 2013

185 FPSOs in service
40 FPSO on order

Gabriel Castaneda, P.E.
## FLNG – Technologies

<table>
<thead>
<tr>
<th>Project / Equipment</th>
<th>Prelude</th>
<th>Kanowit</th>
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<th>Bonaparte</th>
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<td><strong>Capacity</strong></td>
<td>(3.6 MTPA + liquids)</td>
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GDF SUEZ LNG
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## FLNG Projects - Possible

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Thanks!

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